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ABSTRACT

The document offers guidelines for teaching metric measurement to educable mentally retarded (EMR) children. Following a section describing the metric system is an outline of learning characteristics of EMR students. Subsequent sections address methods for teaching linear, weight, and liquid measurement. Stressed is the need for concreteness, practical applications, and reinforcement in teaching the metric system to EMR children. (SBH)

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TEACHING METRIC MEASUREMENT TO EMR CHILDREN

by

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Measurement, should be taught to all EMR children. Measurement, which always involves comparisons and approximations, is a subject that can readily be learned by most EMR children. Metric measurement is easier to learn than the English system with its inches, feet and yards because it is based on the decimal system as is our number and monetary system. It can be readily used to reinforce the learning of place value (ones, tens, hundreds, etc.) of number system and the use of money.

However, the metric curriculum should be organized so that it does not interfere with the children learning the use of numbers. It is advisable that only gross measurements be made in the primary grades, e.g. the meter, the gram and kilogram and the liter in a general fashion, as will be explained later.

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More formal and detailed measurements should not be introduced until the intermediate grades, not until the children have a working knowledge of numbers. This will help them from becoming confused in the use of numbers in the four processes and the use of numbers in comparative measurements. On the other hand, the decimal nature of the metric system more readily lends itself to inclusion in learning the four arithmetical processes than the English system.

Metric System:

On December 23, 1975 President Ford signed the Metric Conversion Act of 1975. Since then more than 30 states have legislation or official state education department policy statements requiring schools to teach the metric system.

One of the many reasons for conversion to the Metric System, or International System of Units, is that this system is a simpler and more natural system of measurement. All of the basic commensurable units are related by powers of ten. We no longer use numbers like 3 (feet in a yard), 12, 16, or 5280 (feet in a mile) as conversion factors. This also eliminates the need for different basic units for each type or amount of measurement. For example, with distance measurements we eliminate the use of inches, feet, yards, miles, rods, fathoms, furlongs, and numerous other difficult

to remember units. All of these are replaced by the one basic distance unit, the meter.

In the metric system there are only a few basic units which must be learned. In fact, the meter, the liter and the gram are essential units for lengths, volume and weights. With each of the units, a prefix may be used to designate a multiple or fractional part of the unit.

kilo means	1,000	milli means	1/1,000
hecto means	100	centi means	1/100
deca means	10	deci means	1/10

The six prefixes are used in length, weight and volume. The following table shows how the prefixes are used in length, but are also applicable to weight and volume:

1 millimeter	(mm)	=	0.001 of a meter
1 centimeter	(cm)	=	0.01 of a meter
1 decimeter	(dm)	=	0.1 of a meter
1 meter	(m)	=	1 meter unit
1 decameter	( )	=	10 meters
1 hectameter	(hm)	=	100 meters
1 kilometer	(km)	=	1,000 meters

The only other important unit of the metric system is the celsius degree to measure temperature. A celsius degree is a little larger than the Farenheit degree. In the celsius system, 0 (zero) is the freezing point for water, 20 (twenty) is comfortable room temperature and 100 is the boiling point for water.

Amazingly enough the above information includes all you really need to know about the metric system. Metrication simplifies the teaching and learning of measurement for children and teachers.

Some interesting comparative measurements are:

Length:

Meter is little longer than a yard.

Kilometer is 3/5 of a mile.

Centimeter is a little less than 1/2 inch.

Millimeter is about the length of a grain of salt.

Weight:

A grain is the weight of paper clip.

A kilogram is little more than two pounds

A person who weights 100 kilograms weights 220 pounds

Volume:

A liter is little more than a quart.

Five milliliters is about a teaspoon of liquid.

Teaching Guidelines

To learn metric measurement, adults need to discard the English system and replace it with the metric system. Whereas children can more readily learn the metric system because they are less indoctrinated with the English measurement.

Therefore, it is best to teach children the metric system with no comparative references to the English system so they will grow up to think in metric measurements.

When working with EMR children it is essential to keep in mind their particular learning style:

1. They learn best through physical and emotional involvement.
2. They are best motivated by fun and pleasurable activities.
3. They learn best (as do all children) through direct experiences using high interest materials.
4. They learn best when new learning or experiences are based on previous knowledge and experiences.
5. They learn best in a structured, sequenced program in which each step of the learning process is well planned.
6. They learn best when many types of stimuli are used -- demonstrations and explanations that are compatible to their mental age, teacher enthusiasm, praise and rewards and the use of concrete teaching aids and materials.

Methods of Teaching

For EMR children much time will have to be spent on "pre-measurement" activities. They need to learn the skills of measurement before they begin using the meter stick or any other standard system of measurement. Formal measuration should be reserved for the intermediate grades. To simplify the metric curriculum for the primary children, linear comparative measurement should be taught first, weight second and volume or liquid measurement, and then temperature.

It prevents the children from confusing one measurement with another in the early learning stages.

Lineal Measurement

The first skill that should be taught is comparisons -- "longer than," "taller than," "shorter than," "same length and," etc. The children would compare the length and height of different objects and themselves. For example, "which is longer a paper clip or a pencil? They could compare their height to that of other children, boys as compared to girls and their height to the teacher's height." They could compare the length of a crayon to a pen or pencil, the length of their thumb to their first finger, the length of their shoes to other children's shoes, the length of the room or door to its width. The idea is to use concrete everyday objects. Often working on the concept of taller, shorter, longer and higher than. The children should find objects that are the same in length and height. Considerable time should be spent on this segment of the lesson.

Following the comparison of objects, the children move into the semi-concrete stages. Here the children draw line segments to illustrate longer, short or the same length. The children can draw the line segments on the blackboard, construction paper and notebook paper freehand or using a straight edge. The line segments can

be drawn in different colors and incorporated in pictures. Teacher can design a worksheet depicting line segments and picture of objects of different lengths to reinforce this activity.

From the semi-concrete stage, the children move on to the use of non standard units of measurement, e.g., a pencil, a book, a string or a stick, etc. to measure his desk as "5" books long, another "8" crayons long, and so on. They could use a blackboard pointer to measure height of the door or children or the length and width of the room. To give the children the idea that we need some sort of standardized measurement to have all the children measure the same object, e.g., a desk. Then discuss each child's measurement -- "the desk is "8" crayons long," "6 pencils long," "4 books long," and so on. The idea of standardization of measurement can be reinforced by giving each child a strip of construction paper the same length and have them measure their desks. Discussion and additional activities should be employed to reinforce the concept of standardization.

Once the children have gained a great deal of experience with the pre-measurement activities, they should begin to recognize the need and use for a standard unit of measurement. At this point, each child should be given and introduced to the meter stick. The children should duplicate the pre-measurement activities using the

meter sticks. They, however, should have a working knowledge of numbers and the basic processes of addition, subtraction, multiplication and division. They should also know how to make change with money.

The linear unit measurements of centimenters, decimeters and meters can readily be learned by equating them with monetary units:

as 100 cents = one dollar, 100 centimeters = one meter
as 10 dimes = one dollar, 10 decimel = one meter
as 10 cents = one dime, 10 centimeters = one decimeter

Most children should be familiar with the concept that a century equals 100 years. From this they should be able to associate that one year is one-hundredth of a century and one centimeter is one-hundredth of a meter. To reinforce the use of linear metric measurement, the activities should proceed as follows. Pupils should:

1. Locate, e.g., 10 centimeters, 30 centimeters, 45 centimeters, 75 centimeters, etc.
2. Measure familiar objects -- pencils, crayons, chalk, height of self and others, desk, etc.
3. Measure and draw line segments on paper, e.g., 5 cm., 16 cm., 29 cm.
4. Estimate length and height of objects first, then measure them to confirm their actual length.

5. Measure parts of body and height of classmates to establish a model for the centimeter, decimeter and meter. The centimeter would be the width of the children's first finger at the second knuckle. The decimeter the length of the children's hand from middle finger to the wrist or the width a child's forehead. The model for the meter could be the height of the shortest child in the classroom or the height of a child from shoulder to floor or the arm spread of child from fingertip to fingertip. Have the children find other examples or models for centimeter, decimeter and meter.

6. Measure the various parts of the body using string or metric tape measure, e.g., distance around head, waist, chest, leg, arm, height, etc. A class graph could be made for each child.

The idea of centimeter and decimeter can be reinforced by writing and stating the measurement of 2 dm. and 3 cm. as 23 cm. and 76 cm. as 7 dm. and 6 cm, etc. Frequent practice must be provided to gain facility in reading the metric instruments. Measurement of concrete objects should be supplemented with teacher-made measurement worksheets. However actual and meaningful objects which are measured for practical reasons have the greatest impact on the children.

Weight Measurement

After the children have a good grasp of lineal measurement, weight measures using scales should be introduced. Again, comparative weighing of familiar objects found in the home and classroom should be the first activities. The teacher should have available in the classroom:

1) a bathroom - type scale to weight the children,

2) a spring or balance scale that would be used in the

kitchen and 3) small balance scales for each child to experiment.

Teacher should concentrate on the grain and kilogram units. Beginning with the gram the children can weigh a paper clip, cube of sugar, various denominations of coins, pencils, hamster, etc. The teacher with the children make a chart on all the objects weighed. Have them bring small objects from home to weigh, e.g., toys, small nails, jewelry, small packages of candy, fruit, vegetables, packaged items found in the grocery store. Attempt to establish a model for a grain. A small paper clip weighs a gram, a cube of suger two grams, a nickel five grams, etc.

The next activity is to weight objects in kilograms (1,000 grams). Begin with weighing the children and make a chart depicting both weight and height of each child. Then select objects from around the room that weigh a kilogram or more, e.g., a box of paper clips, books, desks, chairs, etc. Have children guess the weight of objects on a comparative basis -- "heavier than or lighter than." Then confirm its actual weight by placing it on the scale. The objects could be lined up in order of light to heavy. A chart of the objects should be drawn on the board.

Again, attempt to establish a model as to what a kilogram (2.2 lbs.) is as with the lineal measurement do not discuss pounds, simply deal with weight measurement in terms of grains and kilograms.

After the children have a great deal of experience with weighing objects, give each child three or four objects. Have the children first estimate the weight and write it down, then actually weigh the object(s) to see how accurate they were. Give the children the opportunity to weigh objects and to use the metric system. To teach the idea that there are a 1,000 grams in a kilogram first weight objects that one gram (e.g., a paper clip); then place a 1,000 of the objects on a scale. (It is also a good counting exercise, by weighing 100 of them, then to 200, etc.) The grain and kilogram would be dealt with more extensively in the middle and upper grades.

Liquid Measurement

The comparative approach (greater than, less than) should be used in introducing the metric system of liquid measurement. Begin with the basic unit -- liter, which is a little more than a quart. Use a graduated liter container to measure how much liquid is in a drinking glass, a cup, a drinking mug, a pitcher, a soup can, pop can or bottle, and other containers that children

have experience with or see at home. The gas can (clean one) should be comparatively measured with the volume of a liter container.

It may be a little messy, children should have the opportunity to compare the volume of various containers by pouring water or sand from these containers into the standard liter containers. They can determined if it is a comparative container, e.g. a thermos bottle, is a 1/2 or 1/3 a liter or a liter. Again, the opportunity to develop a model for a liter must be provided, e.g., a liter is equal to a quart of milk. Without mentioning a gallon, use a gallon container to determine the number of liters it contained.

In the later grades, any cooking adventure, which utilizes liquid measurement, is a joyful activity for both boys and girls. Also in the later grades the concept of milliliters and kiloliters would be explored.

CONCLUSION

As the students advance in school and gain increasing experience with the metric system, they should learn to convert from one unit to another. The focus should be on the involvement in measuring concrete objects in and outside of the classroom. As the children continually work with metric measurement, they will find measurement models for the meter, kilogram and liter

that is meaningful to them. It is important that the children learn metric measurement in real and concrete situations. Reinforcement and repetition must be an integral part of metric education for EMR children. Since a certain proportion of their curriculum includes art and handcrafts and other practical arts, all measuration should be in the metric system. The special education teacher has a unique opportunity to teach and reinforce metric measurement in the arithmetic, spelling, social studies and science lessons. Although these suggestions are applicable to teaching the metric system to all children, concreteness, practical application and reinforcement are essential for teaching EMR children.